

CLAIMS

What is claimed is:

1. A purification system comprising:
a substrate; and
a layered catalytic coating applied on said substrate, and said layered catalytic coating comprises a first layer of a photocatalytic coating, a second layer of a photocatalytic metal loaded metal compound coating, and a third layer of a thermocatalytic coating.
2. The purification system as recited in claim 1 wherein said first layer is one of titanium dioxide and a metal compound loaded titanium dioxide.
3. The purification system as recited in claim 2 wherein said first layer is a metal compound loaded titanium dioxide coating and said metal compound is at least one of WO₃, ZnO, CdS, SrTiO₃, Fe₂O₃, V₂O₅, SnO₂, FeTiO₃, PbO, Co₃O₄, NiO, CeO₂, CuO, SiO₂, Al₂O₃, Mn_xO₂, Cr₂O₃, and ZrO₂.
4. The purification system as recited in claim 1 wherein said first layer has a thickness less than 2 μm .
5. The purification system as recited in claim 1 wherein said second layer is a catalytically active metal supported on titanium dioxide.
6. The purification system as recited in claim 5 wherein said catalytically active metal is one of a metal alloy and an intermetallic compound supported on said titanium dioxide.
7. The purification system as recited in claim 5 wherein said catalytically active metal is a Group VIII noble metal.

8. The purification system as recited in claim 7 wherein said Group VIII noble metal is one of rhodium, ruthenium, palladium, iridium, osmium, and platinum.
9. The purification system as recited in claim 5 wherein said catalytically active metal is one of silver and rhenium.
10. The purification system as recited in claim 1 wherein said second layer oxidizes low polarity organic molecules.
11. The purification system as recited in claim 1 wherein said third layer comprises gold on a metal oxide, and said metal oxide is one of titanium dioxide, mixed metal oxides including titanium dioxide, and titanium dioxide loaded with a second metal oxide.
12. The purification system as recited in claim 11 wherein said third layer oxidizes carbon monoxide.
13. The purification system as recited in claim 1 wherein said third layer is applied on said substrate, said second layer is applied on said third layer, and said first layer is applied on said second layer.
14. The purification system as recited in claim 1 further comprising a manganese oxide/metal oxide layer applied on said substrate, and said third layer is applied on said manganese oxide/metal oxide layer, said second layer is applied on said third layer, and said first layer is applied on said second layer.
15. The purification system as recited in claim 14 wherein said manganese oxide/metal oxide layer is manganese oxide and a promoter doped manganese oxide/titanium dioxide.

16. The purification system as recited in claim 14 wherein manganese oxide/metal oxide layer decomposes ozone.

17. The purification system as recited in claim 1 further comprising a light source to activate said layered catalytic coating, and said layered catalytic coating oxidizes contaminants that are adsorbed onto said layered catalytic coating when activated by said light source.

18. The purification system as recited in claim 17 wherein said light source is an ultraviolet light source.

19. The purification system as recited in claim 17 wherein photons from said light source are absorbed by said layered catalytic coating, forming a reactive hydroxyl radical that oxidizes said contaminants in the presence of oxygen and water, and said reactive hydroxyl radical oxidizes said contaminants to water and carbon dioxide.

20. The purification system as recited in claim 17 wherein said contaminants are at least one of a volatile organic compound and a semi-volatile organic compound including at least one of aldehyde, ketone, alcohol, aromatic, alkene, and alkane.

21. The purification system as recited in claim 1 wherein said first layer, said second layer and said third layer are porous.

22. A fluid purification system comprising:
- a container having an inlet and an outlet;
 - a porous substrate inside said container;
 - a device for drawing a fluid into said container through said inlet, flowing said fluid through said porous substrate, and expelling said fluid out of said container through said outlet;
 - a layered catalytic coating applied on said substrate, and said layered catalytic coating includes a first layer of a photocatalytic metal oxide coating, a second layer of a photocatalytic noble metal loaded metal oxide coating, and a third layer of a thermocatalytic coating, and said third layer is gold/metal oxide; and
 - an ultraviolet light source to activate said catalytic coating, and photons from said ultraviolet light source are absorbed by said layered catalytic coating to form a reactive hydroxyl radical, and said reactive hydroxyl radical oxidizes contaminants in said fluid that are adsorbed onto said layered catalytic coating when activated by said light ultraviolet light source to water and carbon dioxide in the presence of water and oxygen.
23. The fluid purification system as recited in claim 22 wherein said fluid is air.

24. A purification system comprising:
a first substrate having a first coating of one of titanium dioxide and metal compound/titanium dioxide; and
a second substrate having a second coating of metal/titanium dioxide; and
a third substrate having a third coating of metal oxide/titanium dioxide.
25. The purification system as recited in claim 24 wherein said first coating is metal compound/titanium dioxide, said second coating is gold/titanium dioxide, and said third coating is manganese oxide/titanium dioxide.
26. The purification system as recited in claim 25 wherein a metal compound of said metal oxide/titanium dioxide is at least one of WO_3 , ZnO , SrTiO_3 , Fe_2O_3 , V_2O_5 , SnO_2 , FeTiO_3 , PbO , Co_3O_4 , NiO , CeO_2 , CuO , SiO_2 , Al_2O_3 , Mn_xO_2 , Cr_2O_3 , and ZrO_2
27. The purification system as recited in claim 25 wherein said third substrate is distal to an inlet of said purification system, and said first substrate and said second substrate are proximate to said inlet of said purification system.

28. A method of purification comprising the steps of:

applying a layered catalytic coating applied on said substrate, and said layered catalytic coating comprises a first layer of a photocatalytic coating, a second layer of a photocatalytic metal loaded metal compound coating, and a third layer of a thermocatalytic coating; and

activating said a layered catalytic coating;

forming a reactive hydroxyl radical;

adsorbing contaminants onto said layered catalytic coating;

oxidizing said contaminants with said hydroxyl radical;

lowering an energy barrier of oxidation of carbon monoxide with said gold of said third layer of said gold/metal oxide coating; and

then oxidizing said carbon monoxide.